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Two new species of the tribe Synanthedonini (Lepidoptera, Sesiidae), with new hostplant associations from Taiwan

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Abstract

Two new species of the tribe Synanthedonini are described from Taiwan: *Synanthedon auritinctaoidis* **sp. nov.** and *Paranthrenella helvola* **sp. nov.** Diagnostic characters for the two species are presented using body color, wing pattern, and genitalia. New records of the relationships between host plants and the immatures are also provided. *S. auritinctaoidis* feeds in the trunk of *Cinnamomum camphora* (Lauraceae) and *P. helvola* in callus tissue of *Helicia formosana* (Proteaceae) or *Prunus campanulata* (Rosaceae).

Keywords

host plants, *Paranthrenella*, *Synanthedon*

Introduction

Clearwing moths (Sesiidae) are a family of small to medium-sized moths that are well-known for their striking mimicry of various Hymenoptera. The Synanthedonini forms the largest tribe in the family Sesiidae Boisduval, 1828 (Špatenka et al. 1999), with 737 species in 38 genera described worldwide (Pühringer and Kallies 2017). The most diverse fauna of clearwing moths, both in species numbers and higher-level diversity, can be found in the tropics and subtropics of the Oriental and Afrotropical regions (Agassiz and Kallies 2018). However, the Synanthedonini fauna of these regions is only incompletely known and many more taxa await discovery or formal description.

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Collecting of clearwing moths during the last decades largely relied on artificial pheromone lures (Gorbunov and Arita 1999, 2000; Arita and Gorbunov 2001, 2002; Kallies et al. 2014). However, these lures were produced on the basis of pheromone components identified for a relatively small number of Palaearctic and Nearctic species, and many taxa that occur in the tropical regions do not respond to these lures. Thus, discovery of the host plants and the rearing of larvae are still critical when assessing Sesiidae distribution and diversity. Most clearwing moths are host-specific, as they utilize only one or few related plants as larval hosts (Špatenka et al. 1999; Ahmad et al. 2001; Robinson et al. 2001, 2002). Liang and Hsu (2015) undertook a survey of the family by exploring potential larval host plants, resulting in the discovery of six new species in the tribe Synanthedonini of Taiwan. We continued to employ this investigation strategy, and subsequently two previously unknown Synanthedonini species were discovered in Taiwan, one in the genus *Synanthedon* Hübner, 1819 and the other in *Paranthrenella* Strand, 1916, based on diagnostic characters in body size, wing pattern, and genitalia.

The present article provides the taxonomic treatments and documents host associations, and immature biology for these two species.

Materials and methods

Adults were collected from flowers or vegetation in the field. Immatures were collected from host plants and reared using an artificial diet. The ingredients of the artificial diet were modified from Liang and Hsu (2015) by adding wood powder of their specific host plant. Forewing length is defined as the distance between the base of the forewing and forewing apex. Genitalia slides were prepared following procedures of Common (1990). Terminology of genitalia follows Klots (1970) and Kristensen (2003), that of wing pattern and venation Špatenka et al. (1999). The names of hostplants follow Boufford et al. (2003). Holotypes will be deposited in the Natural History Museum, London. Additional type series or vouchers are deposited in the following collections abbreviated in the text as follows:

NHMUK Department of Entomology, The Natural History Museum, London;
NTNU Department of Life Science, National Taiwan Normal University, Taipei, Taiwan.

Taxonomic accounts

***Synanthedon auritinctaoidis* sp. nov.**
http://zoobank.org/FA037243-D2EE-4094-98AB-03EC7A78EA9A
Figs 1, 2, 5, 7, 9–11

Type material. Holotype: ♂, HUALIEN: Ruisui, Fuyuan National Forest Recreation Area, 410 m, 18 Feb 2018, reared from *Helicia formosana*, emg. 8 Mar 2014, J.Y. Liang

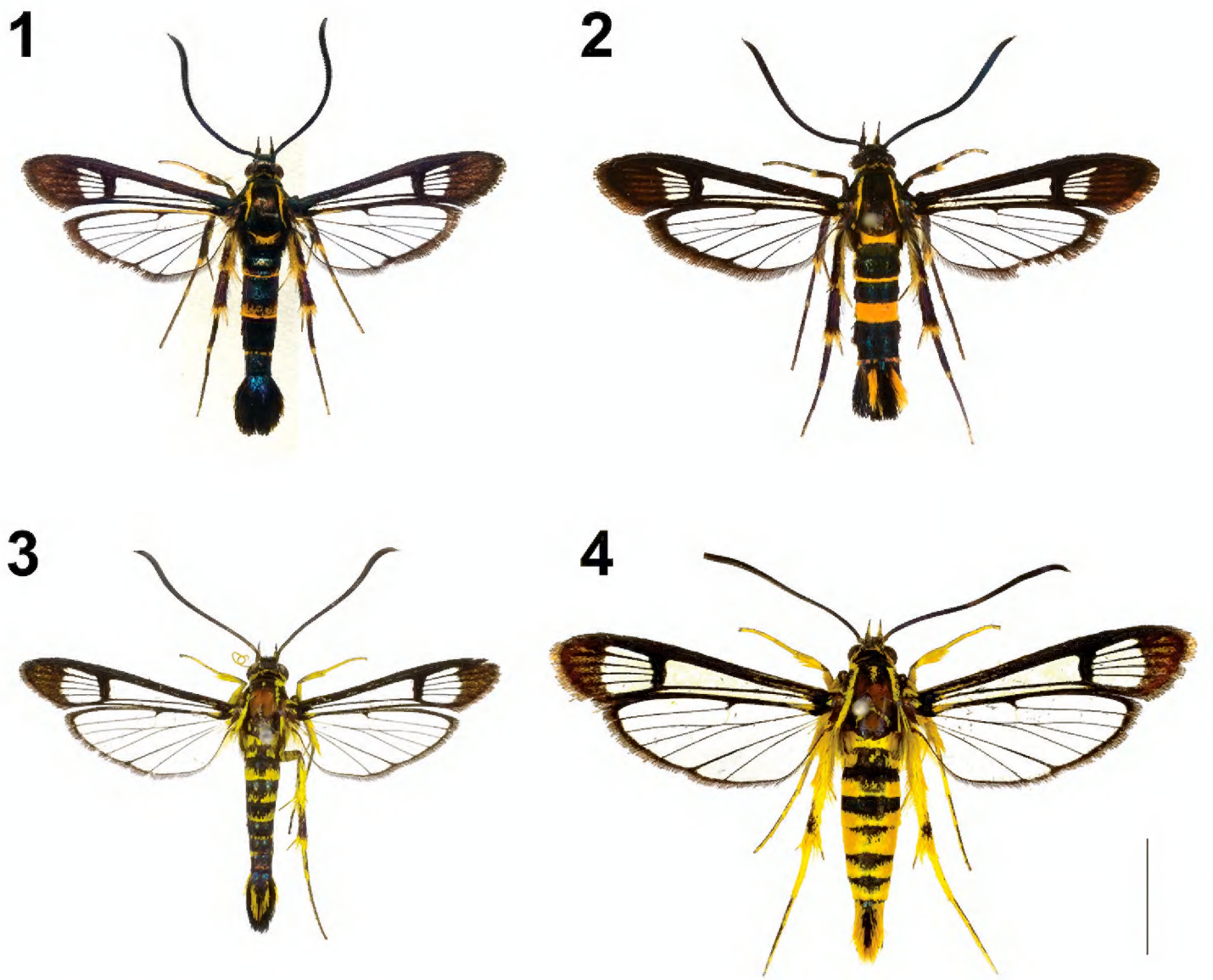
Coll. (NHMUK). Paratypes: 5♀, same locality and date as holotype, emg. 12–24 Mar 2014, J.Y. Liang Coll. (1♀ Gen. Prep. JYL-303) (NTNU); 1♀, same locality, 6 Feb 2016, reared from *H. formosana*, emg. 11 Mar 2016, HSUM 16B82M, J.Y. Liang Coll. (NTNU); 1♂, 4♀, NEW TAIPEI CITY: Shenkeng, Houshanyue, 470 m, 16 Nov 2014, reared from *Prunus campanulata*, emg. 27 Dec 2014–4 Jan 2015, HSUM 14L07M, J.Y. Liang Coll. (1♂ Gen. Prep. JYL-302) (2♀ Gen. Prep. JYL-271 and JYL-306) (NTNU).

Description. Male (Fig. 1): Antenna length 6.9–7.8 mm (n = 2); forewing length 8.4 –9.2 mm (n = 2); body length 10.7–12.1 mm (n = 2). Head: antenna black with blue-violet sheen; frons white; labial palpus black, yellow ventrally; vertex black with purplish sheen; pericephalic scales yellow with a few black scales dorsally. Thorax: patagia black with violet sheen; tegula black, bronzed-blue sheen with a yellow dorsal line; mesothorax black with blue sheen; metathorax yellow; thorax laterally yellow with a few black scales. Legs: fore coxa externally black, internally yellow; fore femur black, with violet sheen; fore tibia dark brown to black, with admixture of yellow scales distally; fore tarsus dorsally dark brown to black, ventrally entirely yellow; mid coxa and femur black, with violet sheen; mid tibia dark brown to black, base-ventrally with a large yellow spot, base of spurs yellow; spurs yellow with black distally; mid tarsus dorsally dark brown to black, with admixture of yellow scales distally, ventrally yellow; hind leg similar. Abdomen: black with blue sheen; tergites 2 and 6 with a narrow yellow stripe distally; tergite 4 with a broad yellow stripe; abdominal tuft black with bronzed-blue sheen, lateral margins with some yellow-orange scales. Forewing: basally black; costal margin dark brown to black; discal spot and veins within exterior transparent area dark brown to black; apical area dark brown with admixture of brown scales; discal spot broad; exterior transparent area large divided into four cells, level to M2 about 1.5×as broad as discal spot and 0.6× as broad as apical area; posterior transparent area reaching discal spot; cilia dark brown. Hindwing: transparent; veins, discal spot and outer margin dark brown to black with bronzed sheen; discal spot small, cuneiform, reaching to vein M2; cilia dark brown, pale yellow anally.

Female (Fig. 2): Antenna length 5.1–6.2mm (n = 9); forewing length 7.9–8.8 mm (n = 9); body length 8.5–10.8 mm (n = 9). Tergite 4 throughout yellow; anal tuft yellow laterally. Other characters identical to those of male.

Male genitalia (Gen. Prep. JYL-302, NTNU, Fig. 5): Tegumen-uncus complex broad; socii well-developed with scopula androconialis, long, about as short as tegumen-uncus complex; uncus with a small narrow wing ventrally; crista gnathi medialis broad, with distal margin divided in two narrow wings; crista gnathi lateralis consisting of a rather broad, subcordiform, distal part and a narrow, crescent-shaped, proximal part; valva elongated, trapeziform, slightly turned down ventro-caudally; crista sacculi well-developed, large, divided into two pocket-shaped parts; dorsal part larger and armed at distal margin with strong, short, slightly bifurcate distally setae; ventral part of crista sacculi narrow, without setae; saccus rounded basally; phallus thin, about 0.8× as short as valva; vesica without cornuti.

Female genitalia (Gen. Prep. JYL-306, NTNU, Fig. 7): 8th tergite relatively large and broad with a few setae at distal margin; posterior apophysis long, about 2× as long as anterior apophysis; ostium bursae opening near anterior margin of 8th sternite;



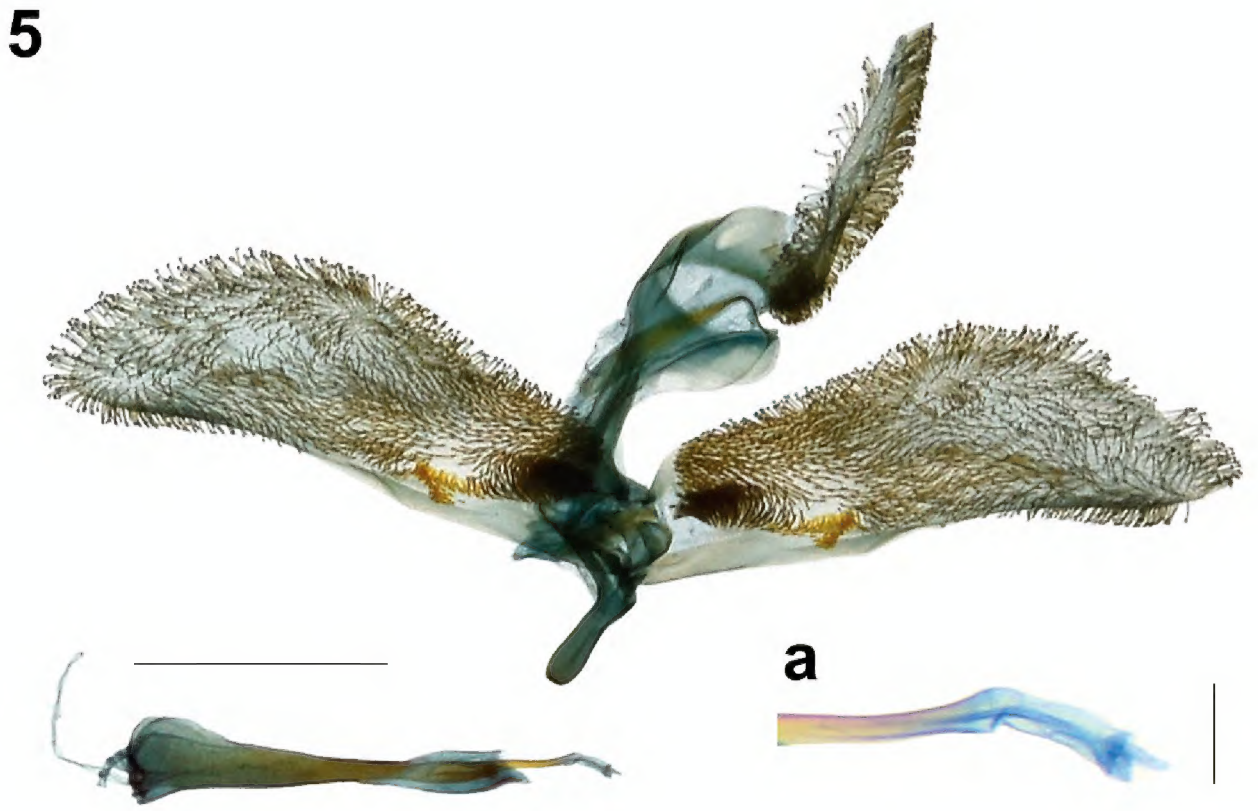
Figures 1–4. Synanthedonini adults **1, 2** *Synanthedon auritinctaoidis* sp. nov. **1** ♂, holotype, Taiwan: Hualien (NHMUK). **2** ♀, paratype, Taiwan: Hualien (NTNU). **3, 4** *Paranthrenella helvola* sp. nov. **3** ♂, holotype, Taiwan: Nantou (NHMUK) **4** ♀, paratype, Taiwan: Nantou (NTNU). Scale bar: 10 mm.

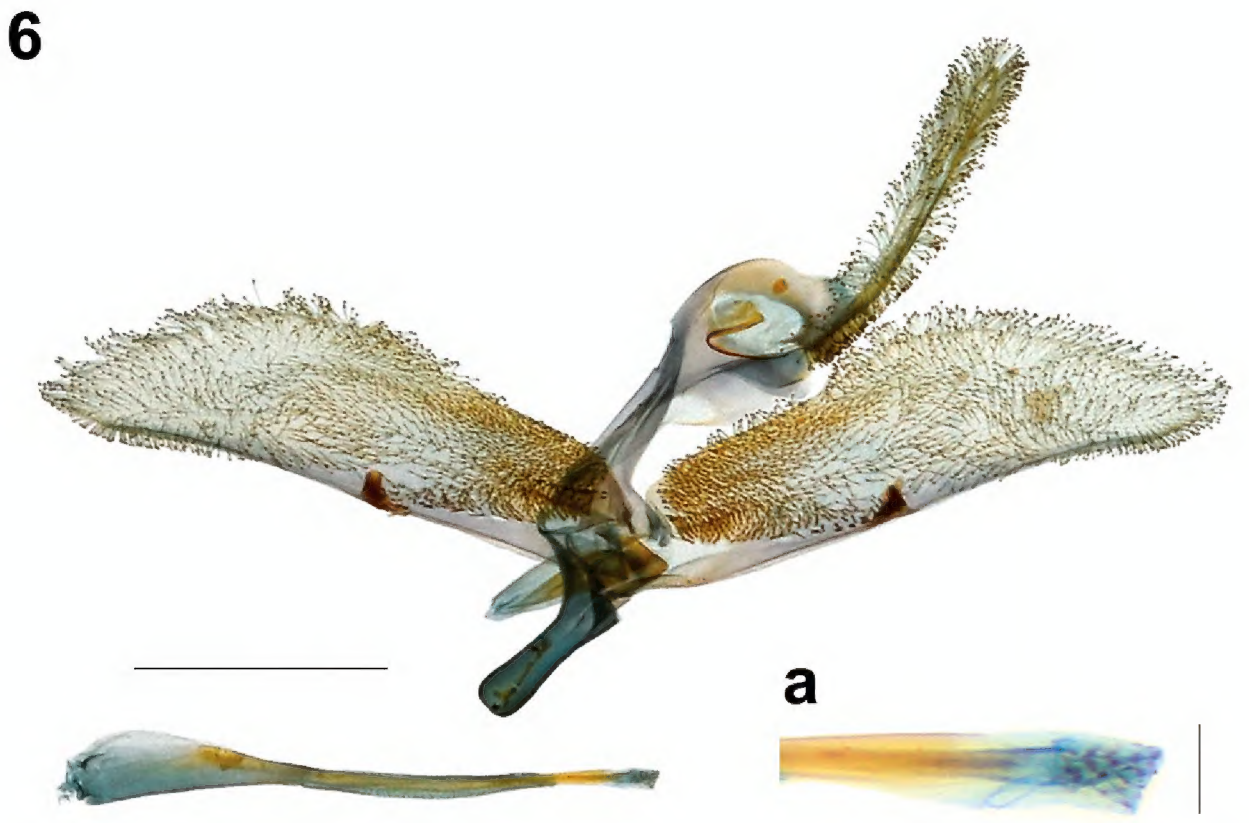
antrum broad ring, well-sclerotized; ductus bursae narrow, long, membranous; corpus bursae membranous, ovoid, without signum.

Diagnosis. *Synanthedon auritinctaoidis* sp. nov. is similar to *S. auritincta* (Wileman & South, 1918) in markings of body and wing, but may be distinguished by the following genitalia characters: saccus base rounded in *S. auritinctaoidis*, but emarginate in *S. auritincta*; phallus without tooth in *S. auritinctaoidis*, but *S. auritincta* with a small, strong tooth ventro distally; ostium bursae opening near anterior margin of 8th sternite in *S. auritinctaoidis*, but middle of 8th sternite in *S. auritincta*; antrum broad ring in *S. auritinctaoidis*, but funnel-shaped in *S. auritincta*.

Etymology. This species is named *auritinctaoidis*, an adjective formed by adding the suffix –oides to *auritincta*, because of its superficial resemblance with *S. auritincta* (Wileman & South, 1918).

Biology. The larva bores into burls of 5–20 cm in diameter on the trunk or branch of *Helicia formosana* Hemsl. (Proteaceae) (Figs 9, 11) or *Prunus campanulata* (Maxim.)





Figures 5, 6. Male genitalia of Synanthedonini. **5** *Synanthedon auritinctaoidis* sp. nov. paratype (NTNU) **5a** distal part of phallus. **6** *Paranthrenella helvola* sp. nov. holotype (NHMUK) **6a** distal part of phallus. Scale bars: 1 mm; 0.1 mm (**5a, 6a**).

Koidz. (Rosaceae) (Fig. 10), and feeds on callus tissue around the hole, which is covered with silk, debris, and frass.

Distribution. Known only from Taiwan.

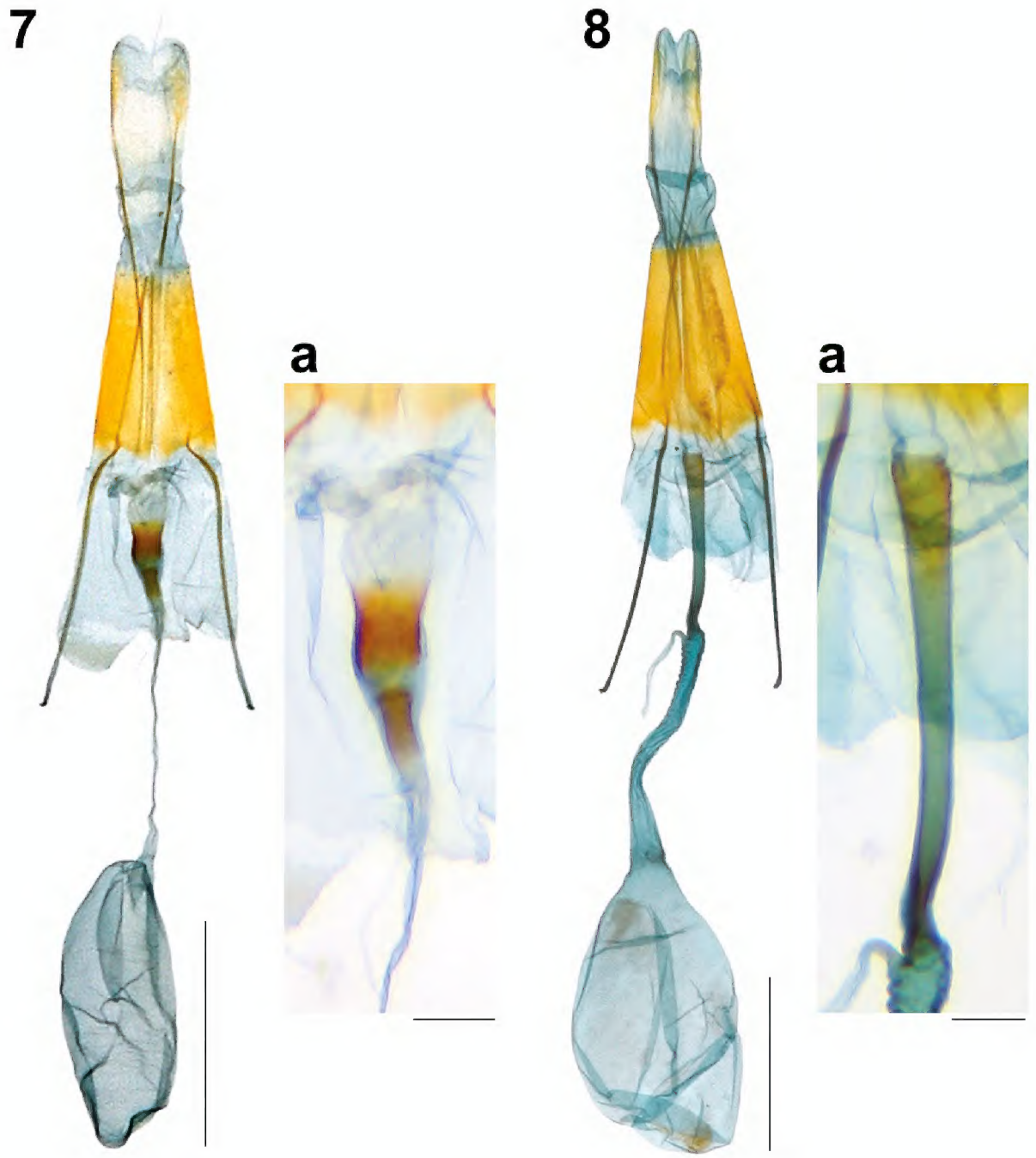
***Paranthrenella helvola* sp. nov.**
http://zoobank.org/996688CE-0504-45CC-B319-3F08ED4114A1
Figs 3, 4, 6, 8, 12

Type material. Holotype: ♂, NANTOU: Renai, Lushan, 1150 m, 23 Jun 2016, on flower of *Ampelopsis brevipedunculata*, J.Y. Liang Coll. (Gen. Prep. JYL-301, NHMUK). Paratypes: 1♀, NANTOU: Renai, Aowanda National Forest Recreation Area, 1240 m, 15 Jul 2016, J.Y. Liang Coll. (NYNU); 1♀, TAOYUAN: Fuxing, Lian, 790 m, 22 May 2018, on trunk of *Cinnamomum camphora*, Y.F. Hsu Coll. (Gen. Prep. JYL-300, NTNU).

Description. Male (Fig. 3): Antenna length 7.2 mm; forewing length 10.3 mm; body length 12.5 mm. Head: antenna black with blue sheen, dorsally and light brown with a few yellow scales ventrally; frons white; labial palpus yellow with black apically; vertex black; pericephalic scales yellow with a few yellow-orange scales. Thorax: patagia dark brown to black, with a small yellow spot laterally; tegula black with a yellow dorsal line, narrowly bordered with yellow scales; thorax laterally yellow with small black scales; mesothorax black with a few yellow scales anteriorly; metathorax yellow, with a few black scales; posteriorly metepimcron and metameron with brown and yellow hair-like scales. Legs: fore coxa yellow with golden sheen, with a broad dark brown to black stripe; fore femur externally dark brown, internally yellow; fore tibia yellow with golden sheen, with admixture of dark brown scales; fore tarsus yellow; mid coxa dark brown to black, with a few yellow scales; mid femur externally dark brown to black, internally yellow; mid tibia yellow, spurs yellow; mid tarsus exterior-dorsally dark brown to black, interior-ventrally entirely yellow; hind leg similar; hind tibia yellow, with a dark brown to black spot distally. Abdomen: dorsally dark brown to black with blue sheen; tergites each with a broad, broadened laterally, yellow stripe distally; abdominal tuft black, dorsal with yellow V shape spot, lateral margins with yellow-orange scales. Forewing: basally black; costal margin dark brown to black, with a narrow yellow stripe between vein Sc and R-stem; discal spot and veins within exterior transparent area dark brown to black; apical area brown with admixture of orange scales; discal spot broad; exterior transparent area large divided into four cells, level to M2 about 3.2× as broad as discal spot and 0.8× as broad as apical area; posterior transparent area reaching distal margin of discal spot; cilia brown. Hindwing: transparent; veins, discal spot black, small, cuneiform, reaching to vein M2; cilia dark brown, yellow anally.

Female (Fig. 4): Antenna length 8.3–8.7 mm (n = 2); forewing length 12.1–12.5 mm (n = 2); body length 13.8–14.1 mm (n = 2). Body and legs with more numerous yellow scales; anal tuft yellow-orange laterally. Color patterns otherwise as in male.

Male genitalia (Gen. Prep. JYL-301, NTNU, Fig. 6): Tegumen-uncus complex narrow; scopula androconialis well-developed, long, about as long as tegumen-uncus complex; crista gnathi medialis relatively long with sinusoid margin; crista gnathi lateralis shorter and narrower than crista gnathi medialis; valva trapeziform-oval, covered with apically bifurcate setae; ventral crista small, covered with triangular flat-topped setae; phallus thin, slightly shorter than valva; vesica with numerous small cornuti.



Figures 7, 8. Female genitalia of Synanthedonini. **7** *Synanthedon auritinctaoidis* Liang & Hsu, sp. nov. paratype (NTNU) **7a** antrum. **8** *Paranthrenella helvola* Liang & Hsu, sp. nov. paratype (NTNU) **8a** antrum. Scale bars: 1 mm; 0.1 mm (**7a, 8a**).

Female genitalia (Gen. Prep. JYL-300, NTNU, Fig. 8): Apophysis posterioris about as long as apophysis anterioris; ostium bursae opening somewhat anteriorly of 8th tergite; antrum narrow, long, about twice shorter than anterior apophysis, well-sclerotized; ductus seminalis just from anterior margin of antrum; ductus bursae membranous, narrow, slightly longer than antrum, gradually broadened towards corpus bursae; corpus bursae globose to ovoid, without signum.

Diagnosis. *Paranthrenella helvola* sp. nov. is similar to *P. similis* Gorbunov & Arita, 2000 which was described from Vietnam. *P. helvola* may be distinguished from *P. similis* by forewing without a transparent area of a cell between veins R4 and R5, with a narrow yellow stripe between vein Sc and R-stem; abdominal tuft with yellow V shape spot of male. *P. helvola* possesses wing pattern similar to *P. albipuncta* Gorbunov

Figures 9–12. Biology. **9** Galls induced by infection of a *Synanthedon auritinctaoidis*. Caterpillar on burls of *Helicia formosana* (Hualien Prefecture, Ruisui Township, Fuyuan National Forest Recreation Area) **10** galls induced by infection of a *S. auritinctaoidis* caterpillar on burls of *Prunus campanulata* (New Taipei City, Shenkeng District, Houshanyue) **11** caterpillar of *S. auritinctaoidis* sp. nov. in burls of *H. formosana* (Hualien Prefecture, Ruisui Township, Fuyuan National Forest Recreation Area) **12** female adult of *Paranthrenella helvola* sp. nov. ovipositing on bark of *Cinnamomum camphora* (Taoyuan City, Fuxing District, Lian).

& Arita, 2000 from Vietnam. *P. helvola* can be distinguished by the coloration of the antenna black, with a large yellow spot in *P. albipuncta*.

Etymology. The name of this new species is the feminine form of the Latin adjective *helvolus,* meaning yellowish, because of the overall yellow coloration of the body trunk and legs of the moth.

Biology. Females lay eggs in the crack of bark (Fig. 12). The larva bores into the trunks of *Cinnamomum camphora* (L.) (Lauraceae) and feeds on callus tissue around the hole, which is covered with silk, debris, and frass. The adults have been observed taking nectar from flowers of *Ampelopsis brevipedunculata* (Maxim.) Traut. (Vitaceae) during day time.

Distribution. Known only from Taiwan.

Remarks. The male genitalia of *P. helvola* sp. nov. are similar to those of *P. albipuncta* Gorbunov & Arita, 2000, but the color of the antenna of these two species differs considerably.

Discussion

Although many plant families are known to be utilized as larval hostplants by sesiid moths, Lauraceae are rarely used, with merely two species recorded: *Paranthrenella weiyui* Liang & Hsu, 2015 and *Ichneumenoptera gryphus* Liang & Hsu, 2015 (Liang and Hsu 2015). *Paranthrenella helvola*, sp. nov. represents the third known species associated with Lauraceae.

Although most clearwing moths are host-specific, utilizing only one or few related plants as larval hosts, their host range seems to increase with some particular modes of feeding. A wider host range seems also to occur in other groups of insects with particular feeding habits (Nyman et al. 2010). For instance, *Synanthedon scitula* (Harris, 1839), a species feeding exclusively on callus, is known to use 17 genera in nine plant families as larval hosts (Robinson et al. 2002). Larvae of *Synanthedon auritinctaoidis* sp. nov. were found feeding on callus tissue of plants in both Proteaceae and Rosaceae, suggesting more plant families may serve as larval diet for this species.

Acknowledgments

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